

November 2013

## Building a STEMI System in Louisiana

### Purpose

ST-segment myocardial infarction (STEMI) is the deadliest form of a heart attack. It results from the complete closure of a major coronary artery.<sup>1</sup> STEMI strikes nearly 250,000 citizens<sup>2</sup> in the United States. When STEMI strikes, opening the artery is of paramount importance using either mechanical or pharmacologic therapies. Primary percutaneous coronary intervention (PCI), the mechanical strategy wherein a balloon is inflated at the site of the closed artery to restore flow, is the most effective course of treatment. Thrombolytic (fibrinolytic) therapy is the next best option.<sup>3</sup> Unfortunately, up to 30 percent of patients in the United States suffering from STEMI never receive either treatment, often times due to the lack of a comprehensive system of care.<sup>4</sup>

Louisiana currently does not have a formal STEMI system of care. The Louisiana Emergency Response Network (LERN) is utilizing a framework of best practices, lessons learned, and existing components to promote and facilitate the development of an ideal STEMI system of care in Louisiana.

This paper describes and explains the STEMI framework.

### Introduction

LERN is an agency of state government, created by the Louisiana legislature in 2004, and charged with the responsibility of developing and maintaining a statewide system of care coordination for patients stricken by serious traumatic injury or time-sensitive illness.

Funding for the establishment of LERN operations began in July 2006. Since then, the LERN Board of Directors (hereafter referred to as “the board”) has established nine regional commissions populated with stakeholder volunteers that live and work within the region they represent. Recognizing the lack of coordinated access to STEMI treatment across the state, LERN formed a workgroup comprised of subject matter experts and invested community leaders throughout the state to develop a system that could provide high level STEMI care to all Louisiana residents.

Per Louisiana legislation RS 40:2845, the board has the duty to work with the Louisiana Department of Health and Hospitals to develop a STEMI system that is designed to promote rapid identification of and access to appropriate STEMI resources statewide. To fulfill this duty, an effective integration plan for pre-hospital emergency medical services (EMS) and hospital processes, in addition to public education and ongoing data review and system management, must be developed. LERN will utilize the following framework to build the ideal STEMI system of care in Louisiana

### I. Access to Definitive Care

In a STEMI, the time between the onset of symptoms and reperfusion (reopening of the artery) is critical.<sup>5</sup> The term “golden hour” is often used to describe the first hour after the onset of symptoms, when STEMI patients receiving definitive care have an increased chance of survival. Currently two forms of reperfusion therapies exist, primary percutaneous coronary intervention (PCI) in a cath lab or fibrinolysis. Both reperfusion therapies can greatly reduce mortality rates in

patients, but the preferred course of treatment for STEMI patients is primary PCI if it can be delivered in a timely manner (fibrinolysis carries a higher risk of bleeding.)<sup>6</sup>

The American Heart Association recommends treatment for STEMI with primary PCI within 90 minutes of medical contact.<sup>7</sup> Unfortunately, access and availability of primary PCI is limited given the need for timely treatment, and the geographic distribution of facilities and resources. In the United States, only 40 percent of patients receiving primary PCI treatment receive this therapy within the American Heart Association’s recommended 90-minute timeframe.<sup>8</sup>

### Long-term Mortality Rates and Treatment Delays

Multiple studies have been published associating the mortality of patients treated with PCI and the ischemic time (the time between the onset of symptoms and reperfusion), including a study conducted in Western Denmark. The study found that a lower PCI delay time resulted in a decreased long-term mortality rate among STEMI patients. **Table 1** demonstrates the long-term mortality rates found among those patients treated with PCI with various treatment delay ranges.<sup>9</sup>

**Table 1: Long-term Mortality Rates and Treatment Delays**

Treatment Delay	Long-term Mortality Rate
0 – 60 minutes	15.4%
61 – 120 minutes	23.3%
121 – 180 minutes	28.1%
181 – 360 minutes	30.8%

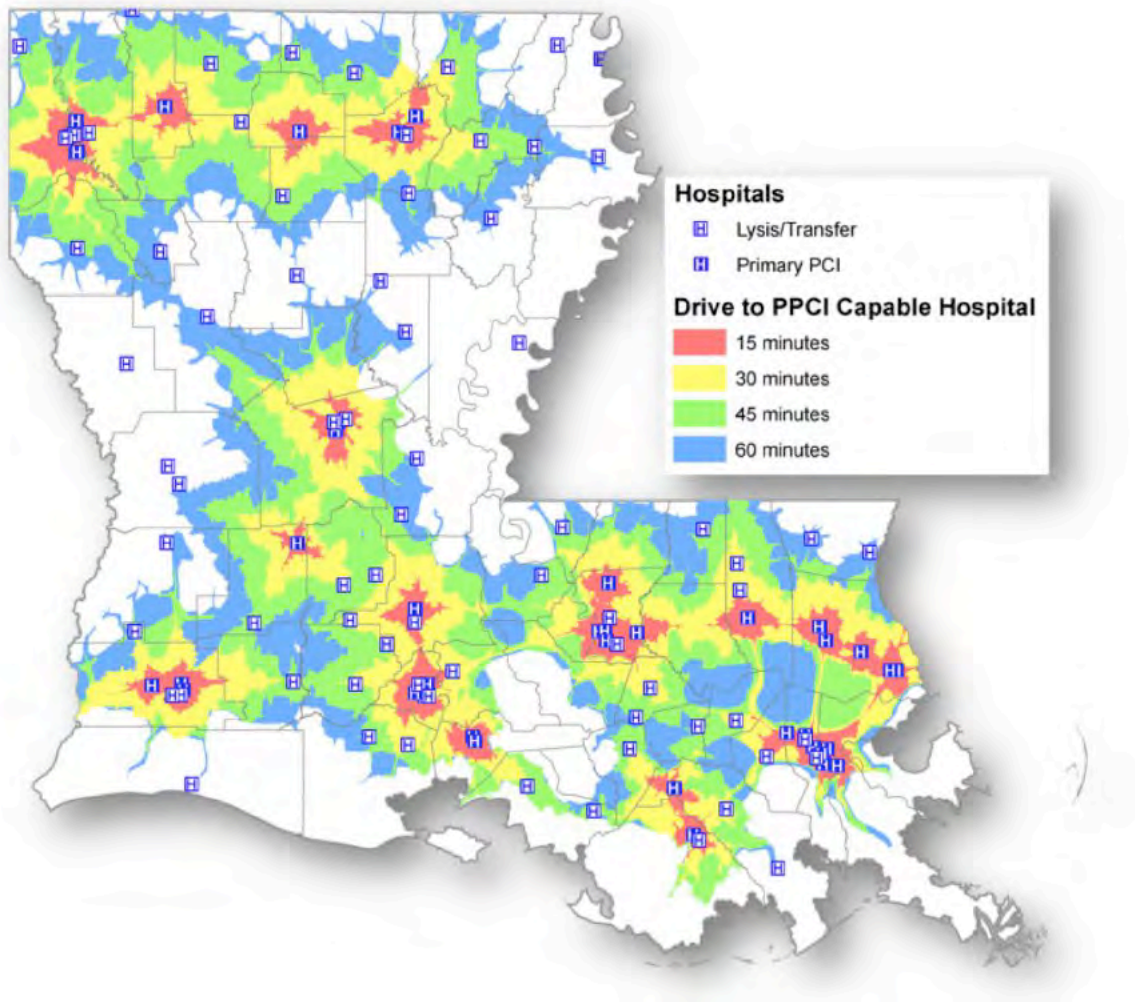
While studies show treatment of STEMI with timely primary PCI is superior to treatment with fibrinolysis<sup>10</sup>, the next best course of action is administering fibrinolysis within 30 minutes of medical contact, followed by transport to a PCI capable hospital<sup>11</sup> for further treatment as needed.

Like many states, Louisiana is challenged to provide timely care because of a variety of factors, including patient recognition of symptoms, early access to medical attention, ability to diagnose STEMI in the field by performing pre-hospital electrocardiograms

(EKGs) and subsequent activation of a cath lab, and triage to centers capable of providing primary PCI within 90 minutes or administering fibrinolysis within 30 minutes. Additionally, any system of care would need to rely on sharing of data between multiple centers to ensure effective clinical care for all patients and (hopefully) an improvement in patient outcomes across the state.

**Figure 1<sup>12</sup>** provides a general picture of the coverage areas available through Louisiana's existing primary PCI capable hospitals.

**Figure 1 – Hospital STEMI Treatment Capabilities and Travel Time to Primary PCI Capable Hospitals**



\*Lysis is synonymous with fibrinolysis capabilities.

The time between the onset of a STEMI and access to definitive care can be lessened through the development and use of operating protocols and procedures that link EMS and hospital providers. To date in Louisiana, some non-PCI and primary PCI capable hospitals have developed well functioning transfer guidelines and partnerships, but the lack of statewide consistency limits access to definitive care making treatment difficult to track and effectiveness difficult to assess.

To reduce mortality by ensuring patients receive the right care in a timely fashion, Louisiana must build upon existing partnerships, continue the establishment of guidelines for primary PCI enabled hospitals, and ensure those hospitals that are not PCI enabled have transfer guidelines in place to seamlessly and quickly provide all Louisiana residents with access to definitive care. To that end, LERN has worked and will continue to work to expand the reach of STEMI treatment, codifying existing partnerships, and establishing treatment and transfer guidelines for pre-hospital and hospital providers.

While adequate facilities and mechanisms for treatment are imperative, they are only one piece of the STEMI system of care in Louisiana. Both pre-hospital providers and residents must be educated on the need and options for timely treatment. LERN has conducted extensive

education and outreach and continues to develop programming to ensure proper identification of STEMI symptoms and guidelines for patient delivery and treatment. Additionally, to gauge the effectiveness of any system, centralized (and anonymized) data sharing will be necessary.

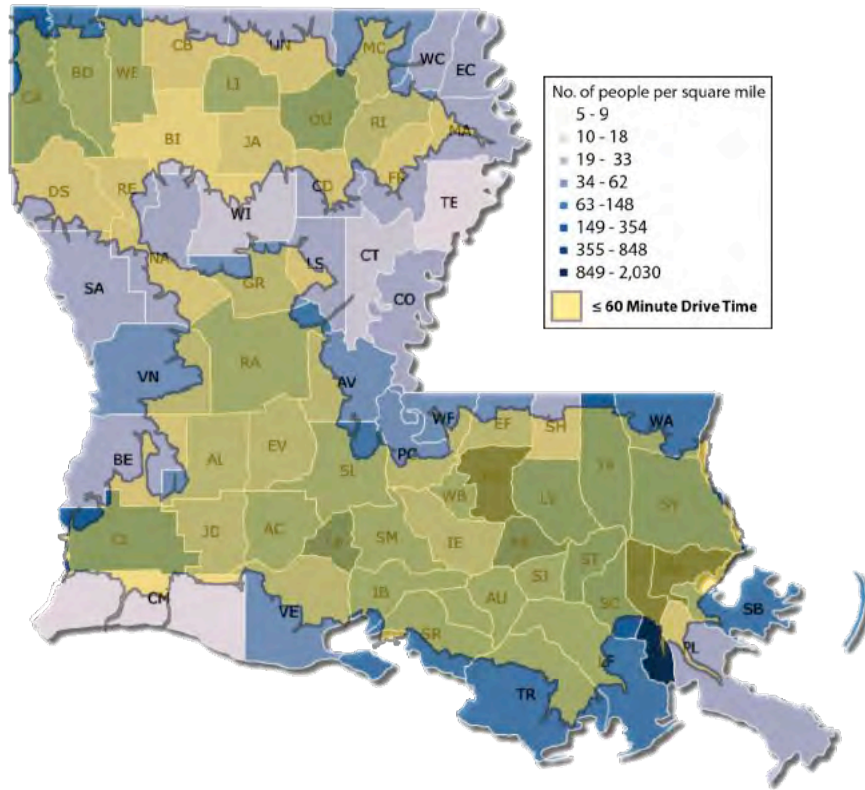
## II. Population Density and Rate of STEMI

Many primary PCI capable hospitals exist in Louisiana but they are unevenly distributed, leaving much of the state's population at risk. While some of the at-risk areas are covered by current transfer partnerships, protocols for transporting patients to definitive care via EMS do not exist, especially in rural areas.

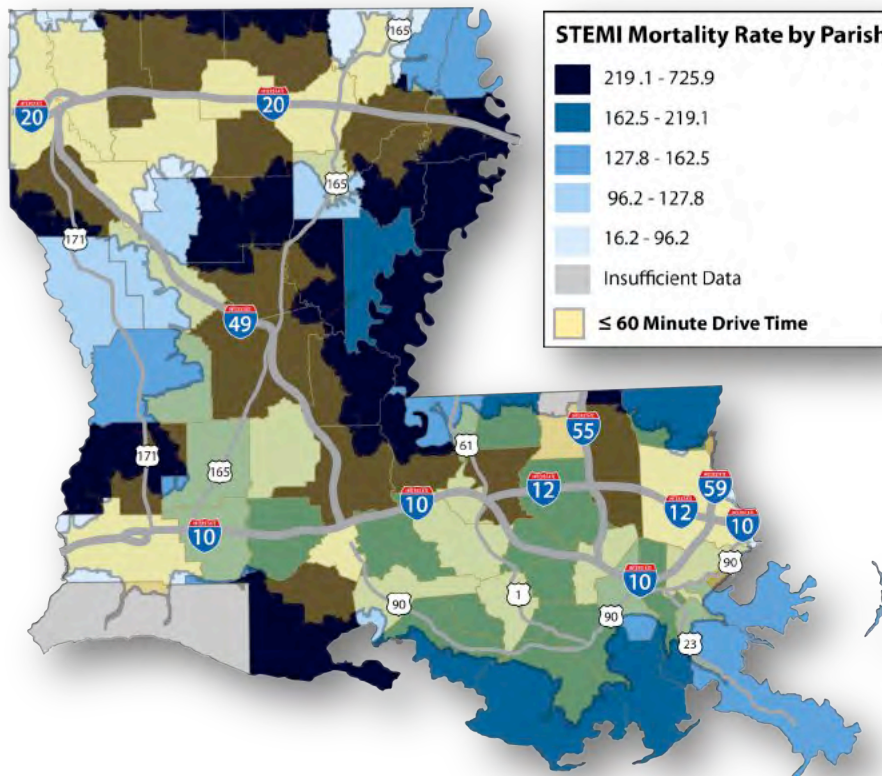
**Figure 2** is a Louisiana population density map with an overlay of current golden hour coverage of PCI enabled treatment centers. **Figure 3**<sup>13</sup> demonstrates the density of STEMI-related deaths across the state and with the golden hour overlay. As shown, many areas with higher rates of STEMI mortality are not within the 60-minute drive time, further building the case for increased access to timely STEMI care for all residents. Together these figures show that many high population and high STEMI mortality areas are not within golden hour coverage.



**Figure 2 – Louisiana Population Density Map with STEMI Golden Hour Overlay**



**Figure 3 – Louisiana STEMI Mortality Map with STEMI Golden Hour Overlay**



### III. Resources

When time is of the essence the best resource to achieve a positive outcome is a well thought out plan. In an effort to create an implementation plan based on a thorough understanding of the unique challenges (by provider type) facing Louisiana, the LERN STEMI workgroup set out to define those resources needed to build a STEMI system of care in Louisiana that would be based upon best-practice guidelines as established by the American Heart Association's Mission Lifeline<sup>14</sup> and successful systems across the country. The workgroup focused primarily on the resources needed to improve outcomes for residents regardless of locale.

The STEMI workgroup identified the following needed resources by provider type.

#### EMS

- Enhanced educational opportunities for paramedics to become facile in EKG performance and interpretation.
- Enhanced educational opportunities for paramedics in EKG interpretation (preferably by local physicians).
- Engagement of EMS and hospital physician leadership in local EKG education for paramedics. Creation of "point person" to serve as liaison between EMS and hospitals to facilitate data sharing and educational efforts.
- Development of relationships and trust between EMS and hospital-based providers. In the event that a hospital chooses to receive EMS EKGs, activation of the cath lab should occur (either by ED physician or cardiologist) while the patient is still en route, allowing for parallel processing of

patient transport and cath lab team mobilization.

- Technologies to address cell signal shortcomings and tracking of successful EKG transmission rates.
- Empowerment of individual regions to create guidelines specific to their region for triage and bypass to facilitate system buy-in.
- Creation of, or participation in, standardized data tracking system, to allow analysis of patient flow from point-of-entry into medical system through definitive care.
- Transparent data system reporting to referring EMS/non-PCI hospitals to guide further system improvement.

#### PCI Hospitals

- Guidelines for pre-hospital cath lab activation via pre-hospital EKG transmission or EMS EKG interpretation.
- Standardized transfer guidelines between PCI and non-PCI centers, with tracking of inter-hospital transfer times.
- Creation of, or participation in, standardized data tracking system, to allow analysis of patient flow from point-of-entry into medical system through definitive care.
- Transparent data system reporting to referring EMS/non-PCI hospitals to guide further system improvement.

#### Non-PCI Hospitals

- For non-PCI centers within a 60-minute travel time to a primary PCI hospital, transfer guidelines that includes universal acceptance. For non-PCI hospitals without nearby primary PCI centers, guidelines for fibrinolysis within 30 minutes and urgent transfer to PCI center.
- Patient education on the need for timely care at the most capable facility.

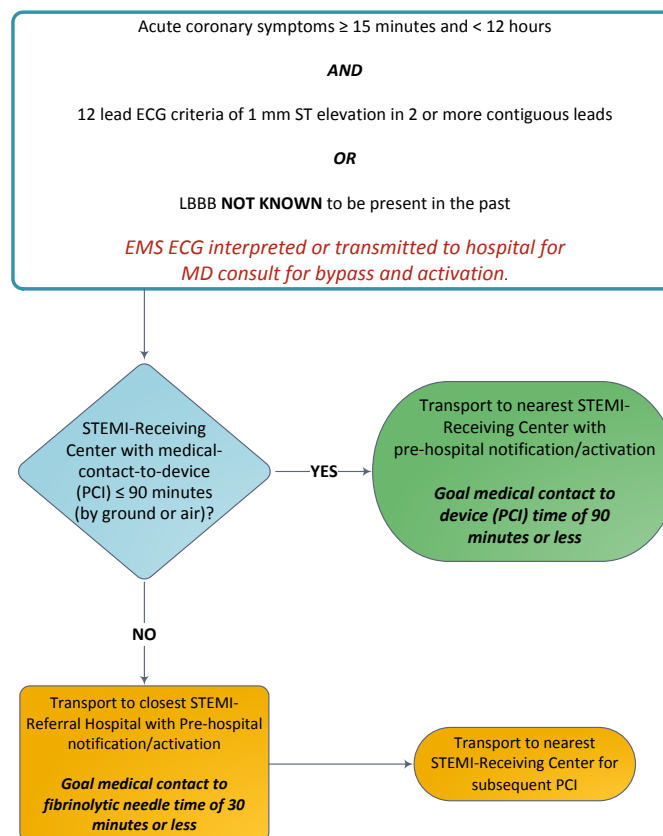
- In non-PCI centers choosing a primary PCI strategy, formal agreements with local EMS providers for emergent (911-level prioritization) transfer of patients to primary PCI enabled hospital.
- Creation of, or participation in, standardized data tracking system, to allow analysis of patient flow from point-of-entry into medical system through definitive care.
- Transparent data system reporting to referring EMS/non-PCI hospitals to guide further system improvement.

As part of the implementation plan and after an introspective look at resources needed to systematically provide access to definitive

STEMI care, LERN developed the following reference documents based upon field best-practice models to detail the process of care by which all STEMI patients should be treated.<sup>15</sup>

- LERN STEMI Triage Protocol for Pre-Hospital Providers (**Figure 4**)
- LERN STEMI Guideline for Patients Self-Presenting to STEMI Referral Center (**Figure 5**)
- LERN STEMI Care Process Flow Chart (**Figure 6**)
- LERN STEMI Receiving Center Requirements (**Figure 7**)
- Thrombolysis Guideline for STEMI Referral Centers (**Figure 8**)

**Figure 4 – LERN STEMI Triage Protocol for Pre-Hospital Providers<sup>16</sup>**



\*O'Gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Journal of the American College of Cardiology. 2013;61(4):e78.

Figure 5 – LERN STEMI Guideline for Patients Self-Presenting to STEMI Referral Center<sup>17</sup>

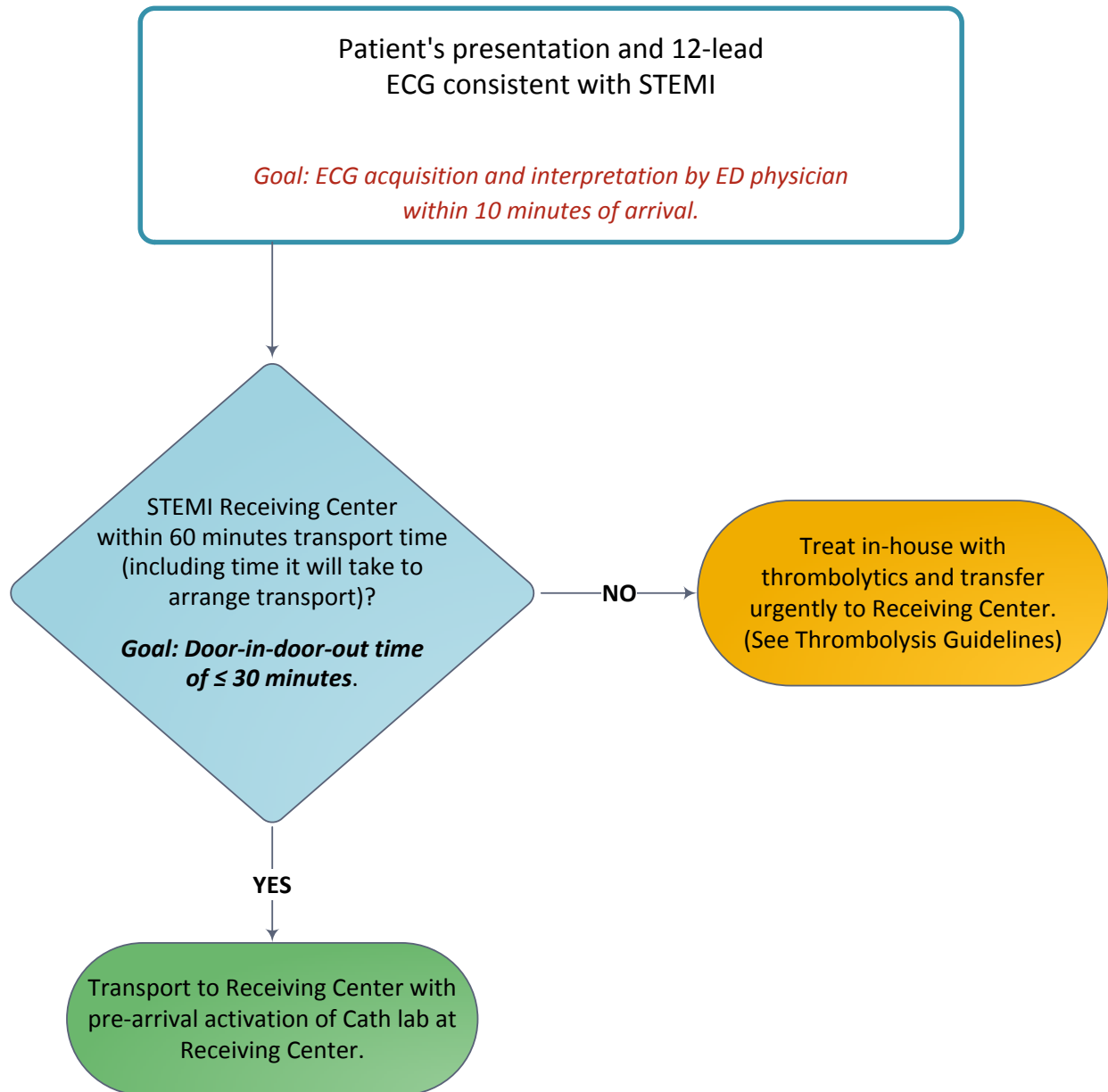
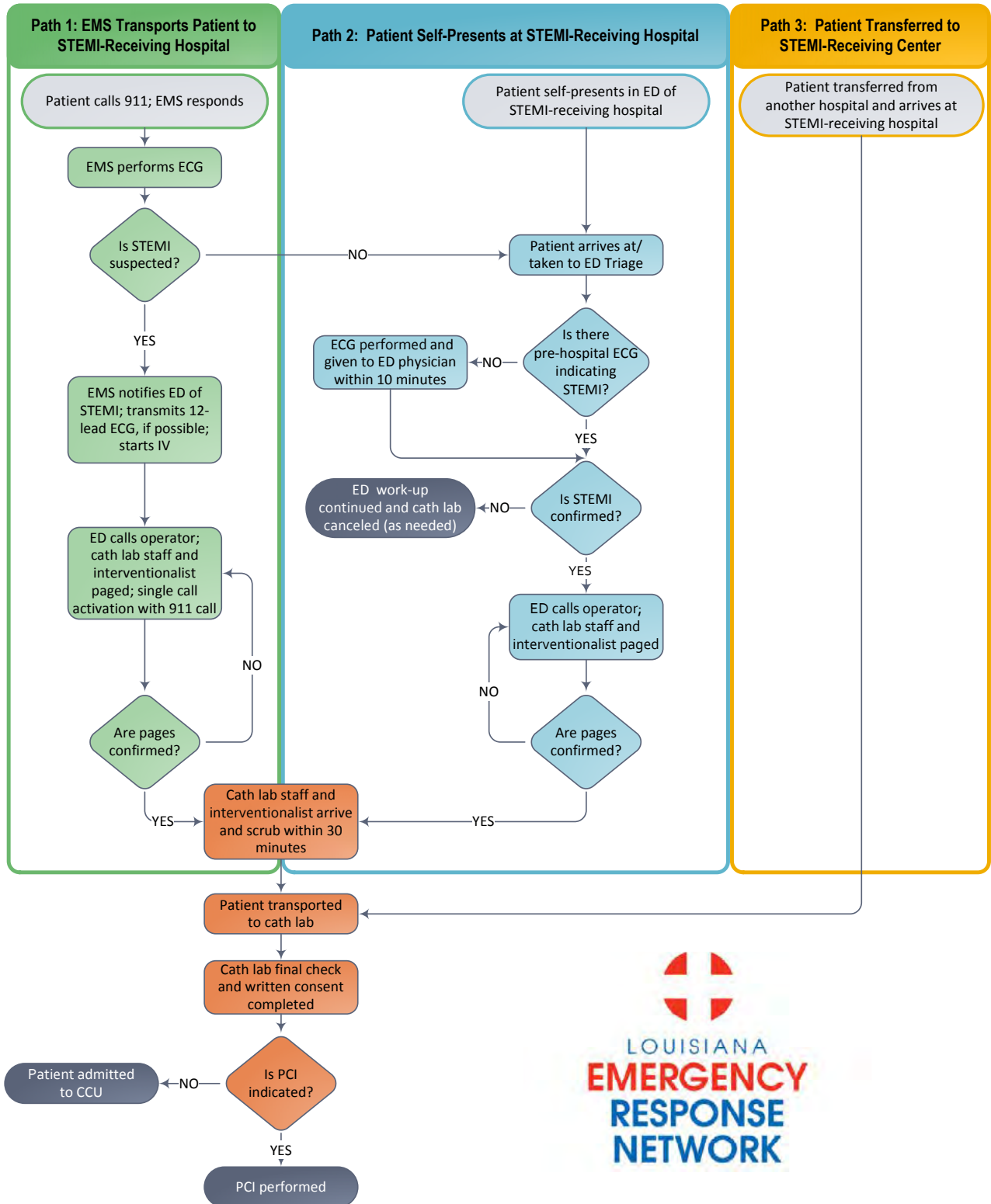




Figure 6 – LERN STEMI Care Process Flow Chart\*



\* Modified from D2B Process Flow Chart: <http://www.d2balliance.org/LinkClick.aspx?link=TK-05-D2BProcessFlowChart.DOC&tabid=141&mid=518>

**Figure 7 – LERN STEMI Receiving Center Requirements**

**Each STEMI-Receiving Center in Louisiana should:**

- 1) Have recognized hospital champion(s) for STEMI care.
- 2) Have 24/7 Cardiac Catheterization Lab (CCL) availability within 30 minutes of notification (including interventional cardiologist present at start of the case).
- 3) Have single call pre-hospital activation of CCL by paramedic or ED Physician for those patients transported by emergency medical services.
- 4) Accept all STEMI patients regardless of bed availability (from EMS and STEMI Referral Centers).
- 5) Have on-site cardiac surgery back up or a pre-designated surgical back up site, and meet hospital procedural volume standards as delineated by the American Heart Association.
- 6) Ensure annual interventional cardiologist volume as delineated by the American Heart Association.
- 7) Have on-going multidisciplinary team meetings to evaluate outcomes and quality improvement data for all STEMI patients. Operational issues should be reviewed, problems identified, and solutions implemented.
- 8) Provide concurrent feedback to EMS and STEMI Referral Centers (including data sharing with EMS or referral Center at the end of case, quarterly meetings to review cases, and data exchange with the EMS/STEMI Referral Center).
- 9) Participate in the LERN STEMI workgroup to contribute to the development and management of a regional STEMI System of Care plan.
- 10) Demonstrate commitment to the Emergency Department (ED) and Cardiac Catheterization Lab having adequate staff, equipment, and training to perform rapid evaluation, triage, and treatment for STEMI patients.
- 11) Demonstrate commitment to developing and/or refining ED and Cardiac Catheterization Lab transfer protocol to be in compliance with the regional STEMI systems of care plan.
- 12) Develop a plan with local prehospital providers to ensure inter-hospital transfers and fibrinolytic-ineligible patients receive highest priority response and are communicated en-route to bypass STEMI Referral Centers (where appropriate).
- 13) Register with American Heart Association Mission: Lifeline as a STEMI Receiving Center and participate in state-wide data collection, quality improvement efforts, and feedback to ensure optimal STEMI care is delivered in Louisiana.

**Figure 8 – LERN Thrombolysis Guideline for STEMI Referral Centers<sup>18</sup>**

## Indications for thrombolysis – Confirmed STEMI with none of the following:

- Contraindications to Thrombolysis\*
- Primary Angioplasty Possible within 90 minutes for patients transported directly to STEMI Receiving Center or within 120 minutes for patients requiring inter-hospital transfer.
- Cardiogenic Shock
- Increased Bleeding Risk
- Symptom Onset > 3 Hours
- Unclear Diagnosis

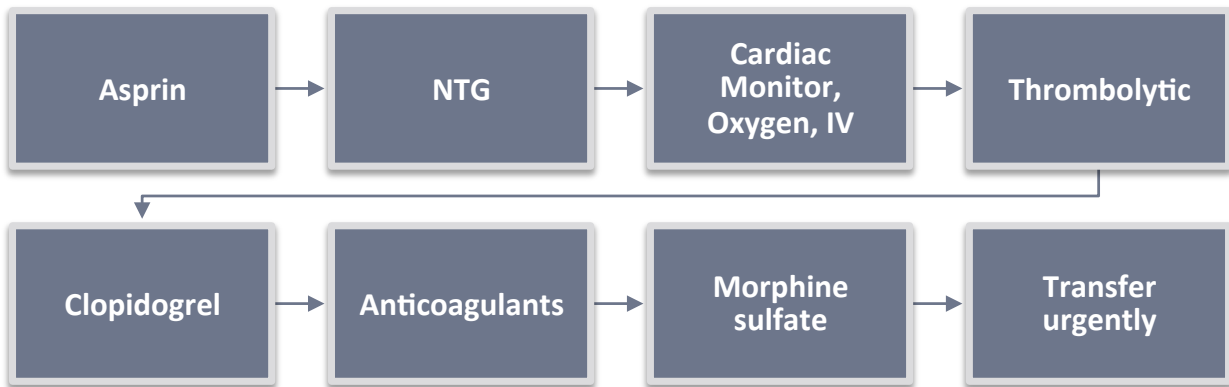
## Contraindications to thrombolysis:

### Absolute Contraindications

- Any prior intracranial hemorrhage
- Known structural cerebrovascular lesion (e.g. arteriovenous malformation)
- Known intracranial neoplasm (primary or metastatic)
- Ischemic stroke within three months (except acute ischemic stroke within 4.5 hours)
- Suspected aortic dissections
- Active bleeding or bleeding diathesis (excluding menses)
- Significant closed-head or facial trauma within three months
- Intracranial or intraspinal surgery within two months
- Severe uncontrolled hypertension (unresponsive to emergency therapy)
- For streptokinase, prior treatment within previous six months.

### Relative Contraindications

- History of chronic severe, poorly controlled hypertension
- Significant hypertension on presentation (SBP >180 mmHg or DBP >110 mmHg)
- History of ischemic stroke greater than 3 months prior
- Dementia
- Known intracranial pathology not covered in absolute contraindications
- Traumatic or prolonged (>10minutes) CPR
- Major Surgery within preceding 3 weeks
- Recent (within 2-4 weeks) internal bleeding
- Non-compressible vascular punctures
- Pregnancy
- Active Peptic Ulcer
- Current use of anti-coagulants; the higher the INR, the higher risk of bleeding.



1. **Aspirin** 325 mg PO or PR x1
2. **NTG** titrated to chest pain and blood pressure.
3. **Cardiac Monitor, Oxygen** for O<sub>2</sub> saturation <94%, **IV** with normal saline
4. **Thrombolytic** dosing:
  - **TNKase**: Single bolus, weight based:
    - < 60 kg = 30mg
    - 60-69 kg = 35 mg
    - 70-79kg = 40 mg
    - 80-89 kg = 45 mg
    - 90 kg = 50 mg
  - OR**
  - **Retepase**: Double bolus
    - 10 units IV over 2 minutes followed by second bolus of 10 units IV thirty minutes later.
  - OR**
  - **Alteplase**:
    - 15 mg IV bolus followed by 0.75 mg/kg (up to 50 mg) IV over 30 minutes then 0.5 mg/kg (up to 35 mg) IV over 60 minutes.
    - Maximum total dose is 100 mg.
  - OR**
  - **Streptokinase** (if not received within prior six months):
    - 1.5 million units IV over 30-60 minutes.
5. **Clopidogrel**:
  - 300 mg PO x1 if ≤75 years of age
  - 75mg PO x1 if >75 years of age
6. **Anticoagulants**:
  - **Unfractionated heparin** 60 units/kg bolus (Max 4000 units) and 12 units/kg/hr infusion (Max 1,000 units/hr)
- OR**
- **Enoxaparin** 30 mg IV if ≤75 years of age.
- OR**
- **Fondaparinux** 2.5mg IV (if not on dialysis)
7. **Morphine sulfate** as needed.
8. Prepare to **transfer urgently** to STEMI Receiving Center for possible rescue PCI.

## IV. The Importance of Data

Hospitals in Louisiana providing care to heart attack patients currently report patient outcomes through CMS core measures but do not share information about patients transported in from or sent out to outside facilities. This results in significant information drop-off, as clinical outcomes for patients undergoing inter-hospital transfer for STEMI care are not available. In designing an ideal system of care for the state, LERN and the STEMI workgroup subject matter experts highlighted the need for meaningful clinical data collection and re-identified data sharing between all hospitals in the state, to ensure that all patients receive optimal care regardless of how they access the medical system. LERN is exploring clinical registries to collect such data while remaining cognizant of avoiding redundancy or unnecessary cost to individual hospitals. Only through robust and rigorous data collection and review will the effectiveness of a statewide STEMI system be demonstrable.

## V. Conclusion

The American Heart Association states it best.<sup>19</sup>

*“In the ideal STEMI system of care all parties with a vested interest in the treatment of STEMI patients – from EMS providers to cardiologists, from hospital administrators to policymakers, and from third-party payers to the public – share a common belief that quality and timely patient care is the top priority. There is a mutual respect for the critical role of each player in the STEMI system. Individual parties are not out to promote their own self-serving interests. Rather, everyone works together to build a consensus on what the ideal STEMI system looks like for their region, considering its unique challenges.”*

LERN has adopted these principles and completed extensive research. Because of this and the dedication of EMS and hospital partners, Louisiana is well on its way to building a STEMI system of care. LERN will continue to lead this priority effort guided by the principles contained within this paper. In the end, LERN’s goal is to meet Louisiana’s STEMI care needs and improve outcomes of all Louisiana residents while using available resources in the most efficient manner possible.

## References

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